

PB-251 762

DESIGN AND OPERATING PARAMETERS FOR EMISSION CONTROL
STUDIES: ASARCO, EL PASO, COPPER SMELTER

I. J. Weisenberg, et al

Pacific Environmental Services,
Incorporated

Prepared for:

Industrial Environmental Research
Laboratory

February 1976

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

110158

EPA-600/2-76-036i
February 1976

PB 251 762
Environmental Protection Technology Series

**DESIGN AND OPERATING PARAMETERS
FOR EMISSION CONTROL STUDIES:
ASARCO, El Paso, Copper Smelter**



REPRODUCED BY
**NATIONAL TECHNICAL
INFORMATION SERVICE**
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

Industrial Environmental Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into five series. These five broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The five series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies

This report has been assigned to the ENVIRONMENTAL PROTECTION TECHNOLOGY series. This series describes research performed to develop and demonstrate instrumentation, equipment and methodology to repair or prevent environmental degradation from point and non-point sources of pollution. This work provides the new or improved technology required for the control and treatment of pollution sources to meet environmental quality standards.

EPA REVIEW NOTICE

This report has been reviewed by the U.S. Environmental Protection Agency, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policy of the Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO. EPA-600/2-76-036i	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Design and Operating Parameters for Emission Control Studies: ASARCO, El Paso, Copper Smelter		5. REPORT DATE February 1976
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) I. J. Weisenberg and J. C. Serne		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Pacific Environmental Services, Inc. 1930 14th Street Santa Monica, CA 90404		10. PROGRAM ELEMENT NO. LAB013; ROAP 21ADC-061
		11. CONTRACT/GRANT NO. 68-02-1405, Task 5
12. SPONSORING AGENCY NAME AND ADDRESS EPA, Office of Research and Development Industrial Environmental Research Laboratory Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Task Final; 4-10/75
		14. SPONSORING AGENCY CODE EPA-ORD
15. SUPPLEMENTARY NOTES EPA Task Officer for this report is R. Rovang, 919/549-8411, Ext 2557.		
16. ABSTRACT The report gives background design data for a specific copper smelter. The data is sufficiently detailed to allow air pollution control system engineering studies to be conducted. These studies will be concerned primarily with lean SO2 streams that currently are not being captured. Physical layout of the smelter and the surrounding area is presented, along with existing control equipment. Ductwork that would be considered for future system tie-in is defined. Emissions from operating equipment, gas flow rates, temperatures, sulfur balance, and a process flow sheet are included. Utilities, stack dimensions, footing requirements, and solid waste handling are defined. Available area for new control equipment, gas characteristic variation, and potential new control equipment installation problems are discussed.		
17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Copper Smelters Design Sulfur Dioxide Utilities	Air Pollution Control Stationary Sources Emission Control Operating Data Solid Waste Handling Wastes	13B 07B 11F
		PRICES SUBJECT TO CHANGE
18. DISTRIBUTION STATEMENT Unlimited	19. SECURITY CLASS (This Report) Unclassified	21. NO. OF PAGES 35
	20. SECURITY CLASS (This page) Unclassified	22. PRICE 4.00-2.25

EPA-600/2-76-036i
February 1976

DESIGN AND OPERATING PARAMETERS
FOR EMISSION CONTROL STUDIES:
ASARCO, EL PASO, COPPER SMELTER

by

I. J. Weisenberg and J. C. Serne
Pacific Environmental Services, Inc.
1930 14th Street
Santa Monica, California 90404

Contract No. 68-02-1405, Task 5
ROAP No. 21ADC-061
Program Element No. 1AB013

EPA Project Officer: R. D. Rovang
Industrial Environmental Research Laboratory
Office of Energy, Minerals, and Industry
Research Triangle Park, NC 27711

Prepared for
U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

TABLE OF CONTENTS

	<u>Page</u>
A. INTRODUCTION AND SUMMARY	1
B. PLANT LOCATION, ACCESS AND OVERALL GENERAL ARRANGEMENT . .	1
C. PROCESS DESCRIPTION	4
D. EMITTING EQUIPMENT	6
a. Roasters	6
b. Reverberatory Furnace	7
c. Converters	10
d. Other Sources	10
E. EXISTING CONTROL EQUIPMENT	11
a. Roasters and Reverberatory Furnace Control Equipment .	11
b. Converter Control Equipment	11
F. GAS SYSTEM DUCTWORK	12
G. SULFUR BALANCE AND GAS COMPOSITION AT SYSTEM EXIT	16
H. GAS CHARACTERISTIC VARIATION	21
I. STACK DESCRIPTION	27
J. PRESENT TECHNIQUE FOR SOLID WASTE HANDLING	27
K. FOOTING AND STRUCTURAL REQUIREMENTS	27
L. EXISTING AND POTENTIALLY AVAILABLE UTILITIES	29
M. POTENTIAL NEW CONTROL EQUIPMENT INSTALLATION PROBLEMS . .	29
REFERENCES	30

LIST OF FIGURES

FIGURE 1. PLANT LOCATION (USGS MAP)	2
FIGURE 2. OVERALL PLANT AND GENERAL ARRANGEMENT (Located in Pocket Inside Back Cover)	
FIGURE 3. PROCESS FLOWSHEET AND SULFUR BALANCE	5
FIGURE 4. GAS SYSTEM DUCTWORK (Located in Pocket Inside Back Cover)	
FIGURE 5. ELEVATION THROUGH PLANT	14
FIGURE 6. R & R PRECIPITATOR OUTLET FLUE	15

TABLE OF CONTENTS (continued)

	<u>Page</u>
FIGURE 7. VARIATION IN SO ₂ CONTENT VS TIME REVERBERATORY FURNACE	22
FIGURE 8. CONVERTER OFFGAS SO ₂ CONCENTRATION VS TIME	23
FIGURE 9. REVERB AND ROASTER STACK	28

LIST OF TABLES

TABLE 1. REVERBERATORY FURNACE DATA	8
TABLE 2. SULFUR BALANCE SUMMARY	17
TABLE 3. ROASTER AND REVERBERATORY FURNACE ELECTRO-STATIC PRECIPITATOR OUTLET FLUE EMISSION DATA	19
TABLE 4. ACID PLANT STACK EMISSION DATA	20

THE FIGURES IN THIS DOCUMENT ARE NONREPRODUCIBLE
THEREFORE ARE EXCLUDED FROM THIS REPORT.

A. INTRODUCTION AND SUMMARY

The purpose of this report is to present background design data on the ASARCO Incorporated El Paso smelter at El Paso, Texas in sufficient detail to allow air pollution control system engineering studies to be conducted. These studies are primarily concerned with lean SO_2 streams that currently are not being captured.

Physical layout of the smelter and surrounding area along with existing smelter and control equipment is presented. Ductwork that would be considered for future system tie-in is defined. Emissions from operating equipment, gas flow rates, temperatures, sulfur balance and process flow sheet are included. Utilities, stack dimensions, footing requirements and solid waste handling are defined. Available area for new control equipment, gas characteristic variation, and potential new control equipment installation problems are discussed. The major uncontrolled sources of SO_2 at this smelter are the four multi-hearth roasters and the reverberatory furnace. Approximately 32,000 tons per year of SO_2 are emitted. Roaster and reverberatory furnace total particulate emissions in 1972 averaged in the range of 21.9 to 45.2 tons per month based on Askania Continuous Stack Sampler readings. ASARCO has indicated that current particulate emissions from the roaster and reverberatory furnace are in the range of 5 to 6 tons per month (Ref. 8).

B. PLANT LOCATION, ACCESS AND OVERALL GENERAL ARRANGEMENT

The ASARCO El Paso smelter is located adjacent to the town of El Paso, Texas. A section of the USGS map showing land contours of the immediate area is presented in Figure 1. Design altitude for the plant is 3,800 feet with latitude $31^{\circ} 47'$ and longitude $106^{\circ} 32'$. The overall plant general arrangement is shown in Figure 2.

The primary particulate emission sources are the crushing and screening operation and the output from the electrostatic precipitators located in the roaster and reverberatory furnace offgas flue and the converter offgas flue. The primary sources of sulfur dioxide are the reverberatory furnace, roasters

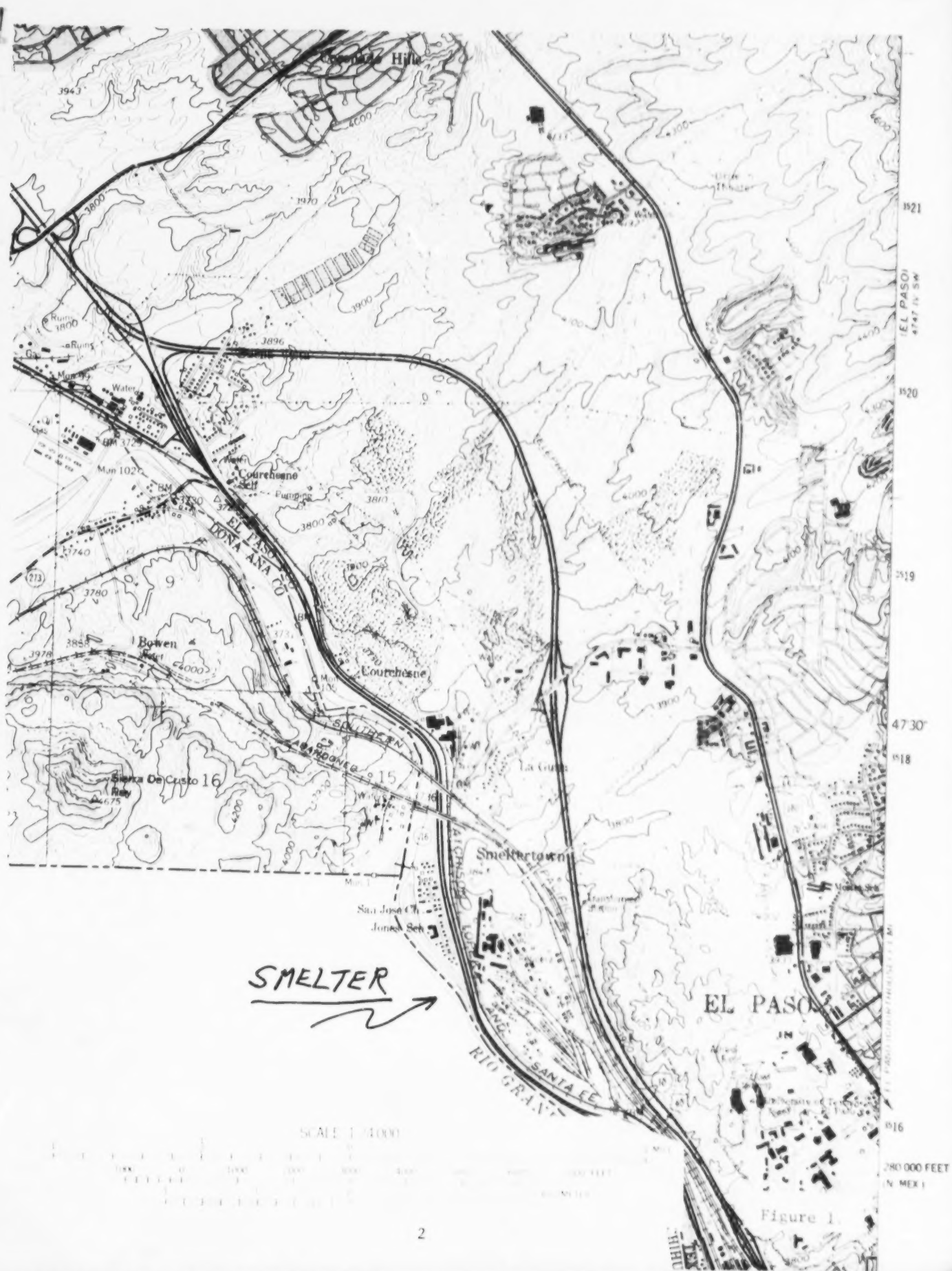


Figure 2. OVERALL PLANT AND GENERAL ARRANGEMENT
(Located in Pocket Inside Back Cover)

and converters. The gases from the converters are passed to a 500 TPD double contact acid plant with measured emissions in the 200 to 300 ppm range. This smelter processes ore from various sources and is considered a custom smelter. The smelter also produces zinc and lead and has separate facilities and circuits for these products.

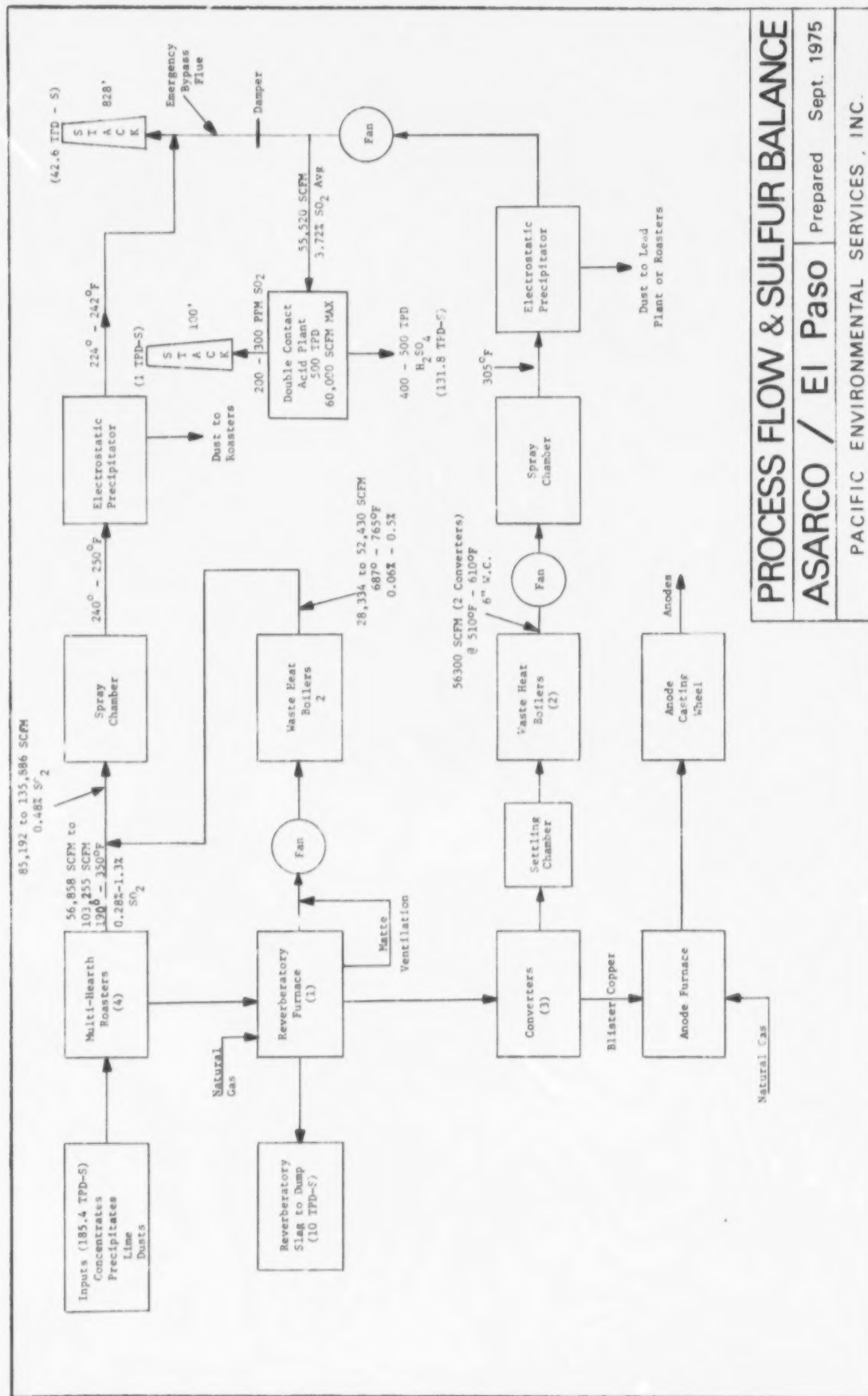
The copper smelter portion of the plant consists of the initial ore handling and mixing equipment, four multi-hearth roasters, one reverberatory furnace and three Peirce-Smith converters. The pollution control equipment consists of a 7 section electrostatic precipitator to handle the offgases from the roasters and reverberatory furnace and an 11 section electrostatic precipitator to handle the gases generated from the converters. The gases going to the sulfuric acid plant are further conditioned by passing through two parallel, two series precipitators located downstream of the converter precipitator, as shown in Figure 2.

Space that would be required for installation of new control equipment appears to be available adjacent to the acid plant, as shown in Figure 2.

C. PROCESS DESCRIPTION

ASARCO operates a custom non-ferrous smelter complex at El Paso, producing lead, zinc, and copper. Only the copper smelting operation is described below. The smelter flow sheet diagram is shown in Figure 3.

A custom smelter is one that accepts ore from any source and processes it, billing each ore shipper. Other smelters are usually associated with a particular mine and process only material from that mine. At El Paso, ore material is received mainly via railroad cars although a small amount of ore is received via trucks. Most of the copper ore is received from Arizona. Ores, converter flux and other smelting materials are stored in a single building. Three bedding bins each of 1700 tons capacity for roaster charge and five 200 ton pocket bins for converter flux and other direct smelting materials are contained in the building. Conveyor belts with water sprays for



dust control are used to transport ore to the roasters.

The feed in the form of precipitates, concentrate, lime, and flue dust is fed to the four roasters. The calcines produced in the roasters are taken by larry car to the reverberatory furnace. Matte from the reverberatory furnace is taken by ladle to the converters and processed to blister copper. The blister copper is further refined in anode furnaces and then cast into anodes for shipment.

Gases from the roasters are combined with the gases from the reverberatory furnace which have been cooled in waste heat boilers. The roaster and reverberatory furnace gases then are cooled in a spray chamber before entering an electrostatic precipitator. From the precipitator the gases go to the 828 foot stack. Gases from the converters are captured in hoods and passed through two waste heat boilers then to a spray chamber and electrostatic precipitators for conditioning before entering a 500 TPD acid plant. The acid plant tail gas is discharged to a 100 foot stack.

Temperatures, volumetric gas flow rates, and SO_2 percentages are shown on the process flow sheet.

D. EMITTING EQUIPMENT

a. Roasters

There are four Herreshoff multi-hearth roasters that receive the smelter mixed charge. Each roaster has seven hearths, is 22 feet 6 inches in diameter, and is capable of producing approximately 392 tons of calcine material per day. In the roasters, which are natural gas fired, moisture and some of the sulfur are driven off. The calcines produced are discharged at about 1000°F . Roaster off-gases are combined with the reverberatory furnace gases, cooled in a spray chamber, and then passed through an electrostatic precipitator before being discharged to the 828 foot main stack.

b. Reverberatory Furnace

One reverberatory furnace 117 feet long by 26 feet 6 inches wide is used at ASARCO/El Paso. The furnace is natural gas fired at a maximum combustion rate of 160,000 SCFH. Number 2 fuel oil is used as a standby fuel during winter months (Ref. 1). Approximately 40,000 tons of calcine per month are processed in the reverberatory furnace. The furnace is charged by Wagstaff guns along the side walls. The calcines are delivered by an elevated trolley train from the roasters. Periodically the reverberatory furnace is charged with molten slag from the converters.

Matte, which feeds the converters, is tapped from the north or south side of the reverberatory furnace into ladles located in the converter aisle. Each matte launder and ladle station is equipped with a pivoted hood, which is lowered over the ladle during the tap. When the tap is completed, the hood is drawn to an upright position by a power winch, thus permitting crane access to the ladle.

Slag is periodically tapped from the west end of the reverberatory furnace and disposed of in a slag dump.

The furnace offgases pass through a pair of waste heat boilers which produce 50,000 pounds of steam per hour. Following the waste heat boilers, the gases are cooled in a spray chamber and then pass through an electrostatic precipitator. The reverberatory furnace gases with the roaster gases, are vented to the atmosphere through the central core of the 828 foot stack.

Each of the five matte tap holes is supplied with a hood, and each of the two launders are covered. The hoods and covers are vented through a fan into the reverberatory flue. This procedure minimizes the low level emissions generated during matte tapping (Ref. 2).

Table I shows reverberatory furnace data for the ASARCO/El Paso smelter taken from Reference 3.

Table 1. REVERBERATORY FURNACE DATA

<u>Furnace Dimensions</u>	
Length Inside	117 ft.
Width Inside Firing End	26 ft. 6 in.
Flue End	19 ft. 6 in.
Height Inside Firing End	4 ft. 9 in. Skim line to center of arch
Flue End	4 ft. 9 in. Skim line to center of arch
Side Wall Thickness at Slag Line	6 in. copper water jacket
Side Wall Thickness above Slag Line	12 in.
Roof Thickness	20 in.
Area Gas Uptake	104 sq. ft.
<u>Refractory Data</u>	
Kind of Brick Roof	Silica
Side Walls	Standard fire brick or Reclaimed silica brick
Hearth Material	Slag
Type and Location of Water Cooling	Copper water jackets along 2/3 of walls from firing end
<u>Firing Data</u>	
Kind of Fuel	Natural gas
Number, Type and Size of Burners	7 multiple jet inspirating burners
Amount of Fuel per Day	2,400,000 cu. ft.
Fuel per Ton of Solid Charge	3,800M. Btu
Fuel per Ton of Total Charge	3,300M. Btu
Temp. Exit Gases	650°F leaving waste heat boilers
Per Cent Calories Recovered in Steam	40
Is Automatic Draft Control Used?	Yes
Type Waste Heat Boilers	400 lb. Stirling
<u>Charge Data per 24 hours</u>	
Wt. Hot Calcine	650 tons

Table 1. REVERBERATORY FURNACE DATA (continued)

Wt. Raw Concentrate	None
Av. Moisture in Raw Conc. Pct.	--
Wt. Crushed Ore	240 tons
Wt. Flue Dust	13 tons
Wt. and Nature of Fettling Material	20 tons slag and matte skulls at bridge wall
Wt. and Nature of Flux	75 tons siliceous ore, 75 tons 3/8 in. limerock
Wt. Liquid Converter Slag	460 tons
Wt. and Nature of Other Material	25 tons foreign matte and slag
Where and How is Furnace Charged	Wagstaff gun feed at side walls
<u>Product Data</u>	
Depth Molten Charge	50 in.
Tons Slag per 24 Hours	550
Method Slag Disposal	Dumped hot
Tons Matte per 24 Hours	400 tons
Vol. Gas per 24 Stand, Cond.	30,200,000 cu. ft.
Per Cent Cu in Matte	38

c. Converters

Three Peirce-Smith converters 13 feet in diameter by 30 feet long are used. Compressed air is introduced through tuyeres into the molten matte. The reaction is exothermic with the products being blister copper, an iron-rich slag, and exhaust gases rich in SO_2 . The blister copper is transferred by ladle to the anode furnaces for further refining, the slag is returned to the reverberatory furnace, and the exhaust gases are collected. Each converter normally processes about 80 to 90 tons of copper per cycle. Each cycle consists of 10 to 12 hours.

Each converter is hooded when in the blowing position to minimize dilution of the SO_2 rich gases. The exhaust gases pass through a settling chamber, two waste heat boilers, a spray chamber, and two parallel electrostatic precipitators on the way to the sulfuric acid plant. Two parallel trains of two electrostatic precipitators in series are included upstream of the acid plant system for further gas conditioning.

Normally, two of the three converters are blowing. Material in idle converters is kept molten by a gas-fired burner placed in the converter opening when it is rotated from under the hood. The maximum gas flow out of the converters is 60,000 SCFM.

d. Other Sources

Two gas-fired horizontal tilting anode furnaces refine the blister copper produced by the converters. Anodes are cast for shipment to an electrolytic refining process. The products of combustion from each anode furnace pass through an afterburner to control particulates and are then vented to the anode furnace stacks.

Material handling in the feed preparation area during crushing and screening operations generates particulate matter.

Leaks in ducts and at other pieces of equipment can release SO_2 and particulate.

E. EXISTING CONTROL EQUIPMENT

a. Roasters and Reverberatory Furnace Control Equipment

Particulate control of roaster and reverberatory furnace gases is accomplished by a spray chamber and an electrostatic precipitator. The precipitator consists of seven parallel chambers each four sections in length with a total of 18,900 cubic feet of electric field. The reported precipitator operating efficiency is 98% (Ref. 4).

b. Converter Control Equipment

Particulate control of converter gases is accomplished by use of a spray chamber and two parallel electrostatic precipitators. The precipitators consist of a total of eleven parallel chambers each four sections in series with a total electric field volume of 33,400 cubic feet. An operating efficiency of 98% is reported (Ref. 4).

Following treatment in the precipitator, the converter gases are sent to a double contact acid plant. The acid plant, installed in December of 1972, has a maximum acid production rate of 500 TPD and a normal production rate of 450 TPD. Either 93% or 98% sulfuric acid is produced. The plant is also capable of producing oleum (110% sulfuric acid containing dissolved SO_3) but has not done so to date. (Ref. 5). Storage tank capacity for 20,000 tons of acid is available at the plant. The acid produced is sold to various shippers including Stauffer Chemical in Houston and Allied Chemical in Denver. ASARCO representatives indicated that the acid is shipped at a loss.

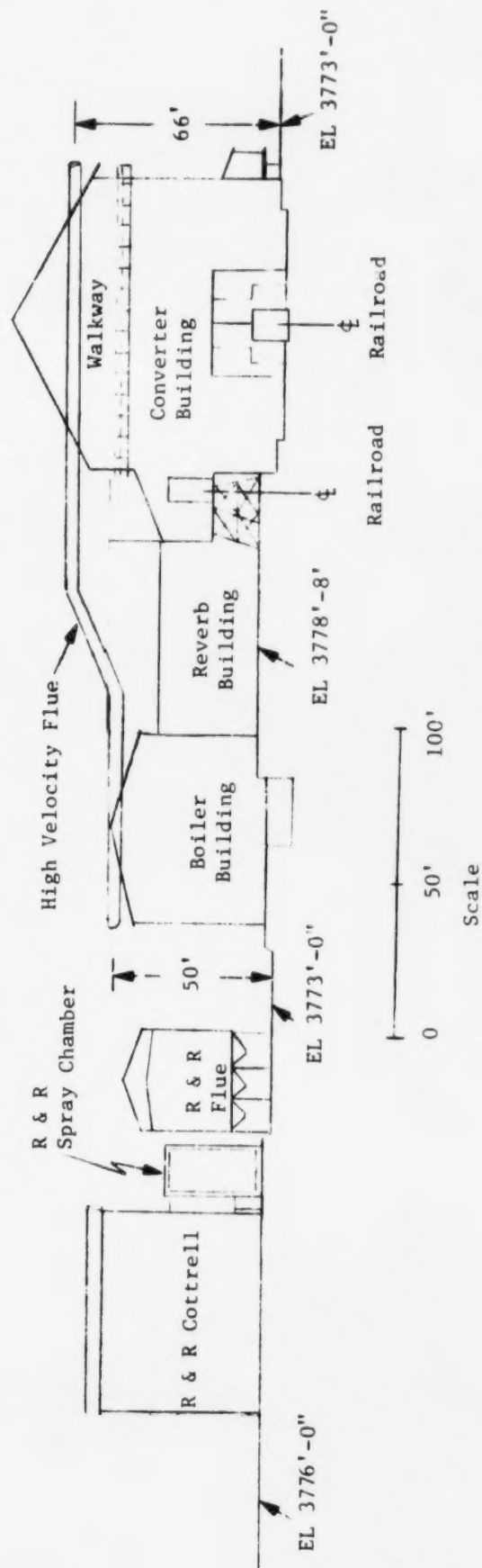
A set of damper controls regulate the amount of gas entering the acid plant. Excess gas from the converters, or all of the converter gas when the acid plant is off stream, is bypassed directly to the main stack. The acid plant tail gas is sent to a 100 foot stack.

F. GAS SYSTEM DUCTWORK

A plan view of the gas system ductwork is presented in Figure 4. Figure 5 shows an elevation view of the plant. The roasters are connected to the main roaster and reverberatory furnace flue by a 14 foot 6 inch wide by 12 foot high duct. This roaster duct passes through the south side of the Number 2 Roaster Building and travels east to the main roaster and reverb flue.

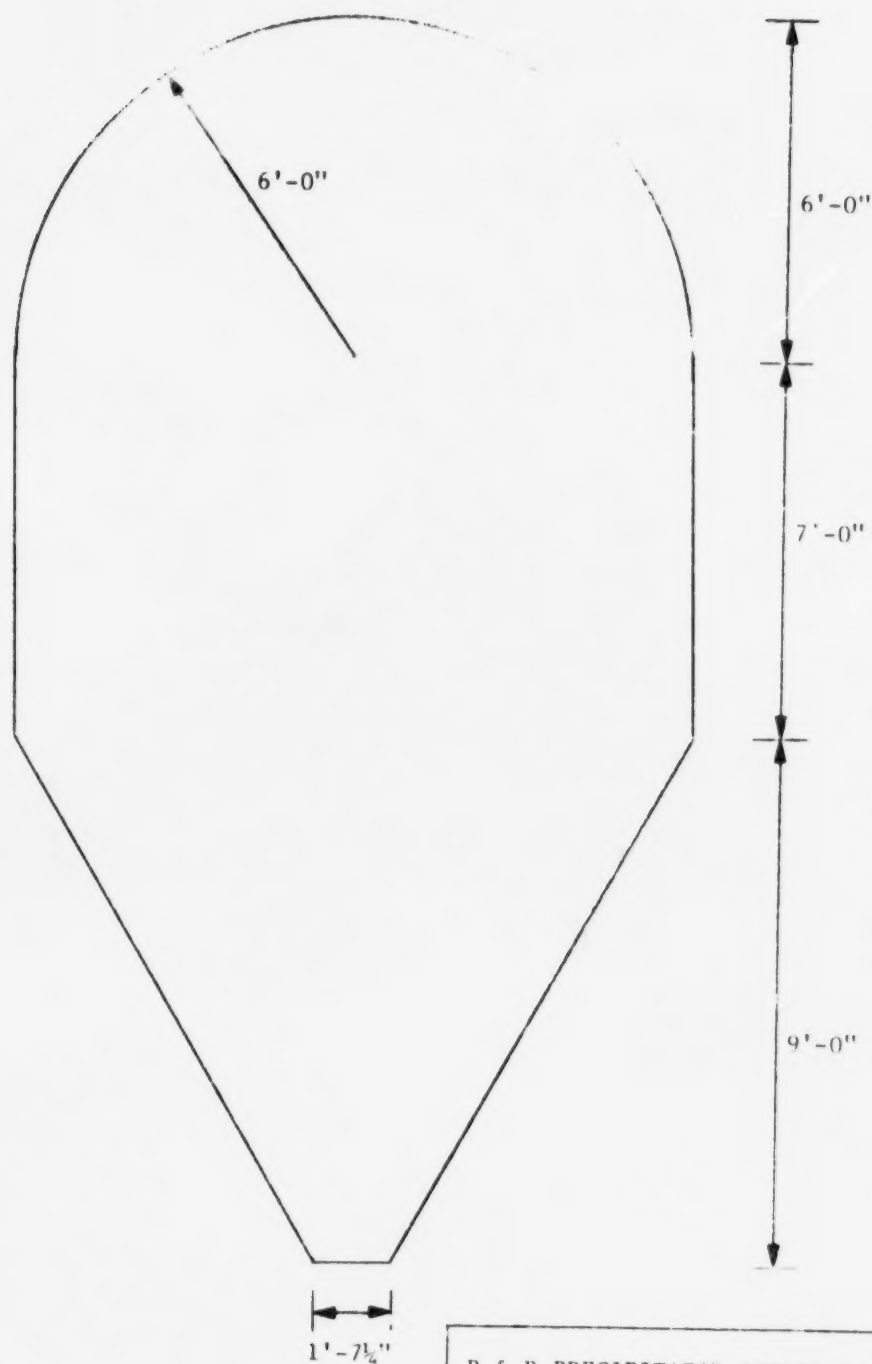
Gases from the reverberatory furnace pass through two parallel waste heat boilers and then through two parallel 6 foot by 6 foot ducts to the main roaster and reverb flue. The overall dimensions of the main roaster and reverb flue are 30 feet wide by 30 feet high and 175 feet long. The combined roaster and reverberatory furnace gases are then cooled in a spray chamber with approximate dimensions of 15 feet wide by 30 feet high by 170 feet long. After cooling, the roaster and reverberatory furnace gases are treated in an electrostatic precipitator consisting of seven parallel chambers with four sections per chamber. The precipitator outlet flue is balloon shaped as shown in Figure 6. The distance between the precipitator outlet and the stack is approximately 115 feet. Gases from each converter uptake hood pass through two 5 foot diameter ducts to draft control dampers and then through shut off valves to the inlet flue of two parallel waste heat boilers. The outlet flue from the waste heat boilers is connected to two 4 foot diameter high velocity flues which carry the gases 510 feet to the hot gas fan which pressurizes the gases. The gases then pass through a 6 foot 6 inch diameter flue to a spray chamber. The spray chamber is approximately 105 feet long. The cooled gases travel through a 6 foot 6 inch diameter duct to an electrostatic precipitator consisting of eleven parallel chambers with four sections per chamber. Originally four of the eleven chambers were used to treat the roaster and reverberatory furnace gases, but a new seven chamber precipitator was built to perform this task. From the precipitator the gas travels through a connecting flue to an intermediate fan before traveling

Figure 4. GAS SYSTEM DUCTWORK
(Located in envelope inside back cover)



ELEVATION THROUGH PLANT	
ASARCO/EL PASO	Prepared Sept. 1975
PACIFIC ENVIRONMENTAL SERVICES, INC.	

Figure 5



R & R PRECIPITATOR OUTLET FLUE	
ASARCO/EL PASO	prepared Sept. '75
PACIFIC ENVIRONMENTAL SERVICES, INC.	

Figure 6

to the acid plant. The connecting flue contains a damper which allows the converter gases to go directly to the main stack in case the acid plant is off stream.

G. SULFUR BALANCE AND GAS COMPOSITION AT SYSTEM EXIT

Typical sulfur balance data are presented in Table 2. Of the 185.4 tons per day of sulfur entering the smelter approximately 141.8 tons per day are captured (131.8 TPD captured in the acid plant and 10 tons per day are contained in the slag and solid wastes). With these values, the "overall" sulfur control efficiency is:

$$\frac{141.8}{185.4} \times 100\% = 76.5\%$$

Most of the sulfur is released in the roasters and the converters. Presently only the converter gases are treated for SO₂ removal.

Volumetric gas flow rate, SO₂ concentration, and mass sulfur emission data for the major pieces of smelting equipment are listed below: (Reference 6)

Roasters

Total gas volume	80,057 SCFM average
SO ₂ concentration	0.76% average
	0.28% to 1.3% range
Mass emission rate	6522 lb/hr as SO ₂
	78.2 TPD as SO ₂
	39.1 TPD as S

Reverberatory Furnace

Total gas volume	30,483 SCFM average
SO ₂ concentration	0.18% average
	0.06 to 0.5% range
Mass emission rate	588 lb/hr as SO ₂
	7.1 TPD as SO ₂
	3.5 TPD as S

Table 2. SULFUR BALANCE SUMMARY

Sulfur Input	Roaster		Reverb		Converter		Slag and Solid Waste	Fugitive Emissions	Present Sulfur Captured	Stack Emissions
	%SO ₂	TPD-S	%SO ₂	TPD-S	%SO ₂	TPD-S				
185.4	0.76 (0.28 to 1.3)	39.1	0.18 (0.06 to 0.5)	3.5	3.72	132.8	10.0	-	141.8	43.6

Combined Roaster and Reverberatory Furnace Gases

Total gas volume	110,540 SCFM average
SO ₂ concentration	0.60% average
Mass emission rate	7092 lb/hr as SO ₂
	85.2 TPD as SO ₂
	42.6 TPD as S

Converter

Total gas volume	55,500 SCFM average
SO ₂ concentration	3.72% average
	22,140 lb/hr as SO ₂
	265.7 TPD as SO ₂
	132.8 TPD as S
	407 TPD as H ₂ SO ₄

The Texas Air Control Board sampled the roaster and reverberatory furnace electrostatic precipitator outlet flue and the acid plant stack in November of 1973 (Ref. 7). The results obtained at that time are summarized in Tables 3 and 4. Note that the SO₂ mass emission rate measured in the roaster/reverb precipitator outlet flue represents the minimum amount of SO₂ emitted from the main stack during the sampling period. The main stack is fed by an additional flue from the converters. The mass emission rate of SO₂ and particulates from this flue depend on the amount of converter gas bypassing the acid plant.

The dust emitted from the main stack is reported to have the following composition (Ref. 6).

Lead	4.3% b.w.
Copper	4.9% b.w.
Zinc	10.2% b.w.
Sulfates as sulfur	11% b.w.
Arsenic	(among other constituents not measured)
Antimony	

Table 3. ROASTER AND REVERBERATORY FURNACE ELECTROSTATIC PRECIPITATOR
OUTLET FLUE EMISSION DATA

<u>Traverse</u>	<u>Particulate Mass Emission Rate</u> lb/hr	<u>SO₂ Mass Emission Rate</u> lb/hr
2	54.88	12,320.1
3	38.33	10,549.0
4	42.94	11,391.6
5	31.46	11,816.1
6	43.67	14,215.3
7	38.95	13,414.8
AVERAGE	41.71	12,284.7

Sampling dates November 10, 11, 12, 13 and 14, 1973

Average Percent Water	8.88%
Average Specific Heat	7.1583 Btu/lb mole °F
Average Density of Stack Gas	0.04788 lb/ft ³
Average Velocity	21.71 ft/sec
Average Gas Temperature	231°F

Table 4. ACID PLANT STACK EMISSION DATA

<u>Traverse</u>	<u>Particulate Mass Emission Rate</u>	<u>SO₂ Mass Emission Rate</u>	<u>H₂SO₄ Mass Emission Rate</u>
	lb/hr	lb/hr	lb/hr
2	6.7	9.0	2.06
3	12.7	22.5	4.42
4	5.1	15.3	2.16
5	7.2	26.0	2.62
AVERAGE	7.9	18.2	2.81

Sampling dates November 8, 9 and 10, 1973

Average Percent Water	0.43%
Average Specific Heat	7.0083 BTU/lb mole °F
Average Density of Stack Gas	0.05627 lb/ft ³
Average Velocity	57.96 ft/sec
Average Stack Temperature	147°F

H. GAS CHARACTERISTIC VARIATION

It can be expected that SO_2 concentration in the offgas from the reverberatory furnace will vary significantly with time. This results from the variation in time required for decomposition or reaction of the various sulfide ores charged to the furnace. This variation in SO_2 content has been known to range as much as 10 to 1 within a given charging time cycle. The curve in Figure 7 shows variation of SO_2 content vs. time for the reverberatory offgas. Consideration of this variation must be included for control system design.

SO_2 concentration in the converter offgas will also vary considerably for an entirely different reason. The operation of a converter usually includes three slag blows and one copper blow. Between these blows the converter may be rolled out for slag pouring or material charging. When the converter is not blowing, the hood above the converter is closed off by dampers so that the gases do not pass through the collection system to the acid plant. An attempt is always made to maintain at least one converter blowing gases into the system at any given time. Usually 18,000 to 20,000 SCFM will be introduced to the converter tuyeres. Additionally, 100 to 120% dilution air is added to this gas flow resulting in a total gas flow from each converter in the range of 35,000 to 40,000 SCFM. An average of 55,000 SCFM of converter gas with an SO_2 concentration of about 4% is sent to the acid plant. Strip charts of typical SO_2 concentration variation with time in converter offgases are shown in Figure 8.

Because of the normal fluctuation in converter feed and operation, the SO_2 concentration can vary over a relatively wide range. In addition, the gas volume flow from the converter line to the control system acid plant can usually vary over a wide range from maximum to zero. Operation of the control system must be conducted in a manner to compensate for these fluctuations. Acid plant operation at this smelter appears to be typical providing reasonably satisfactory control. Significant on-time data have not yet been accumulated because of the relatively short time the plant has been in operation.

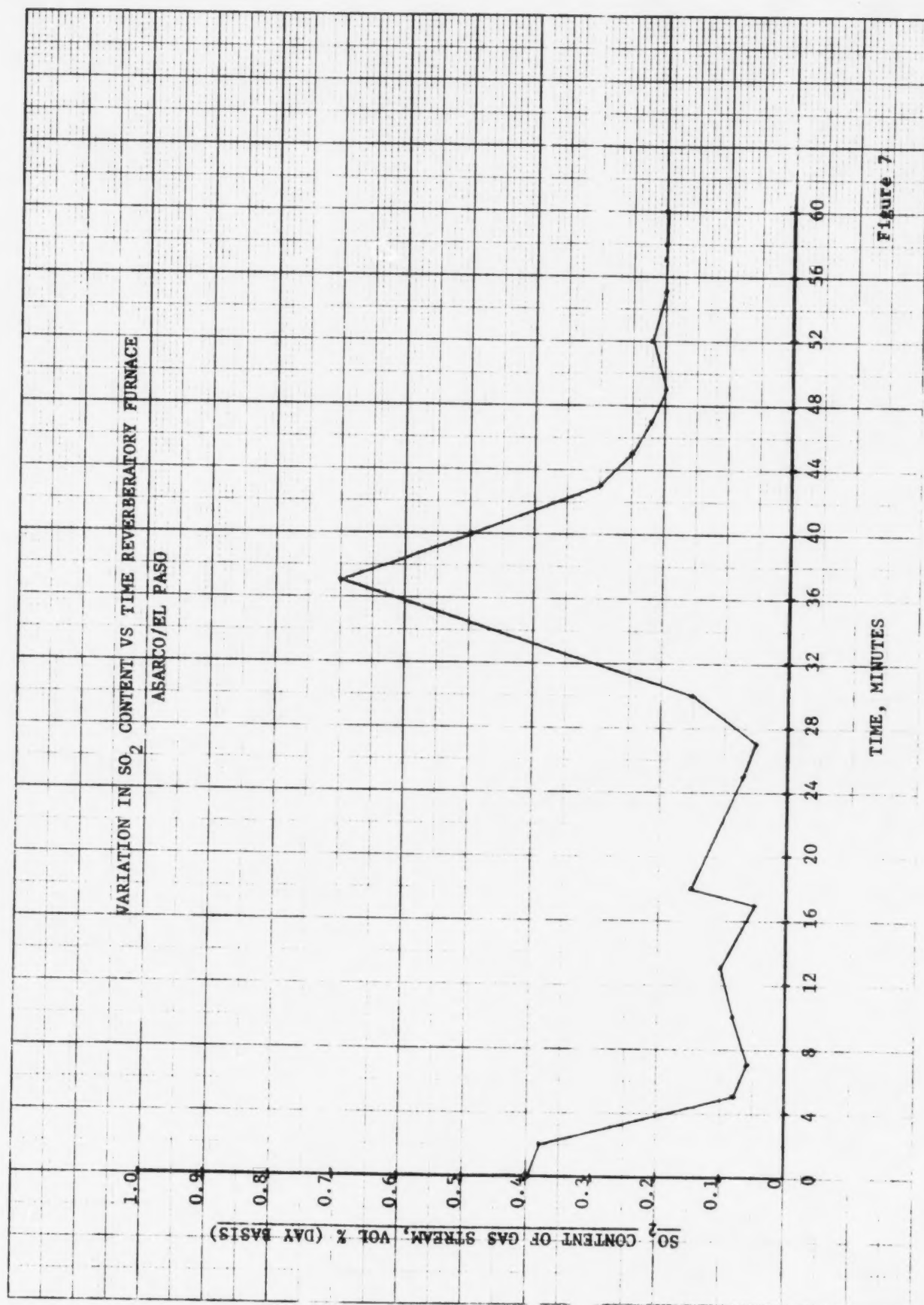
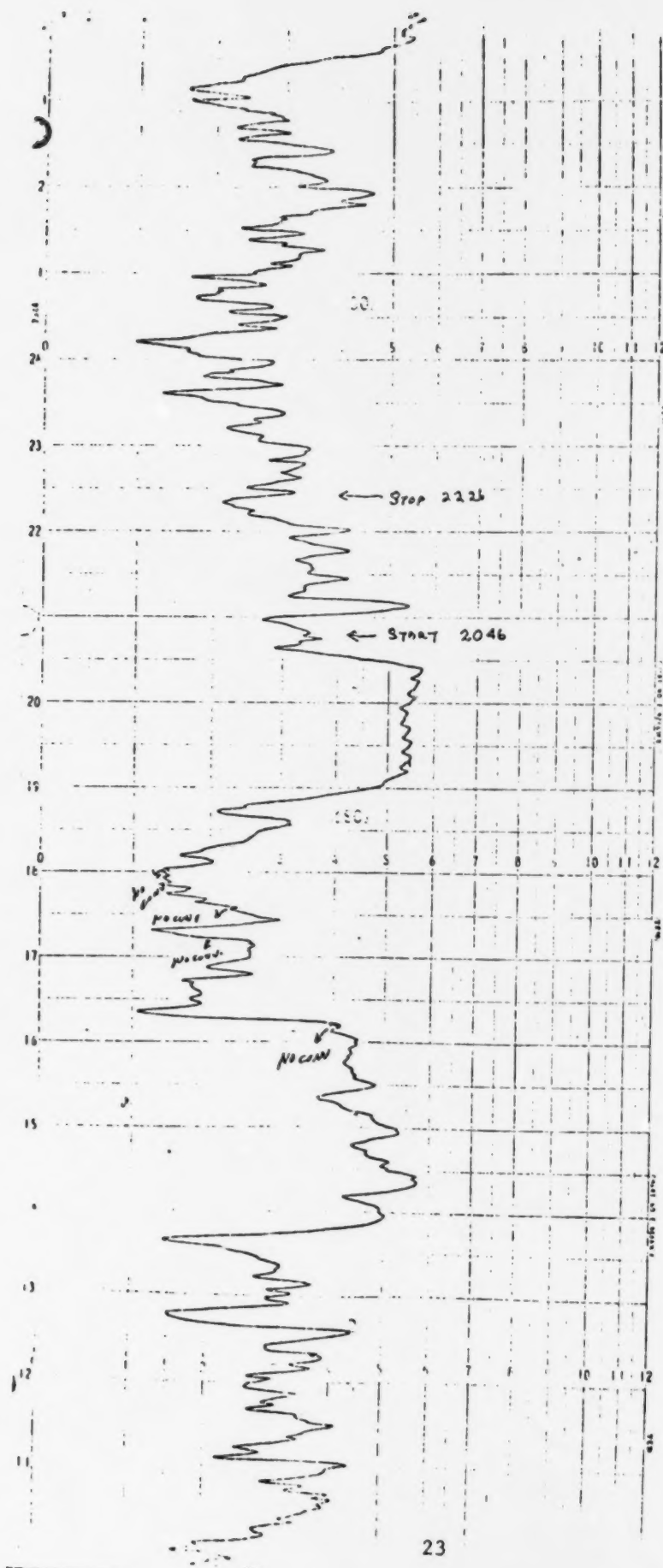
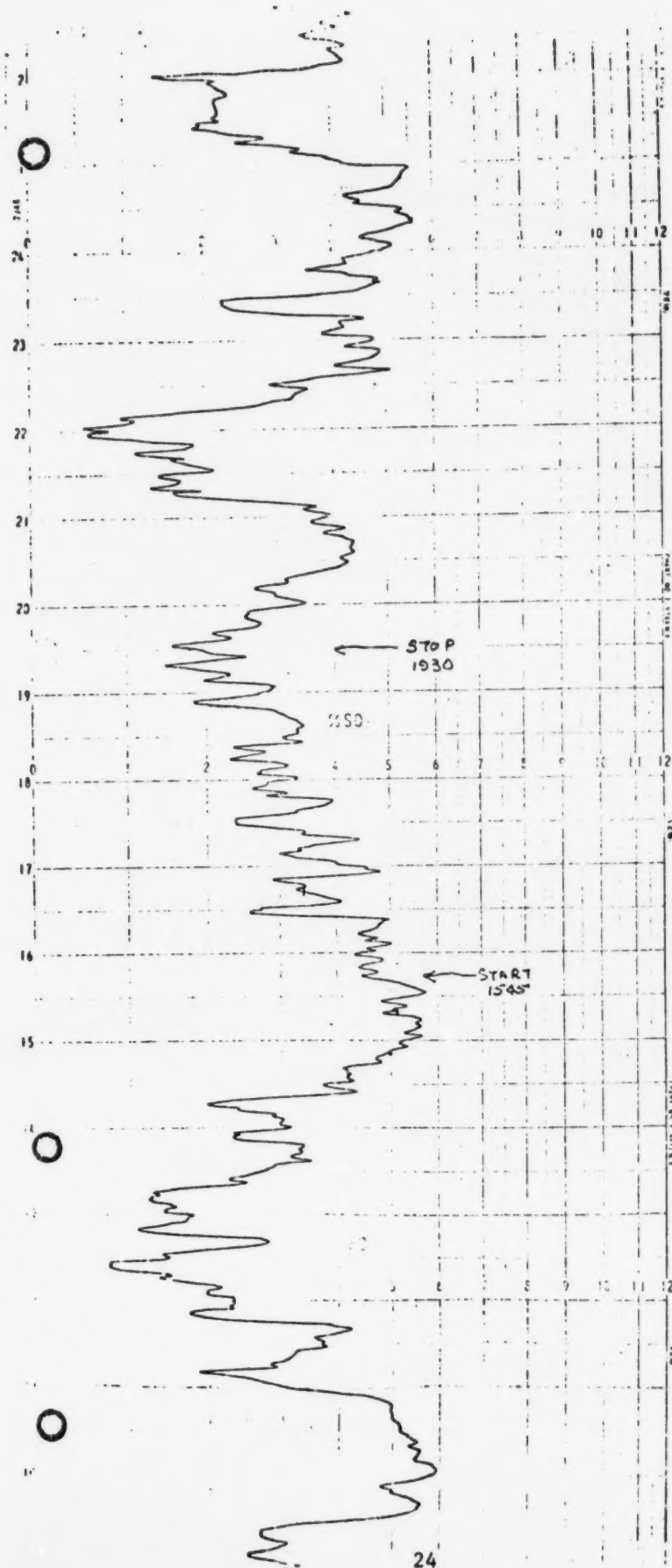


Figure 7



CONVERTER OFFGAS
SO₂ CONCENTRATION
vs. TIME

Figure 8

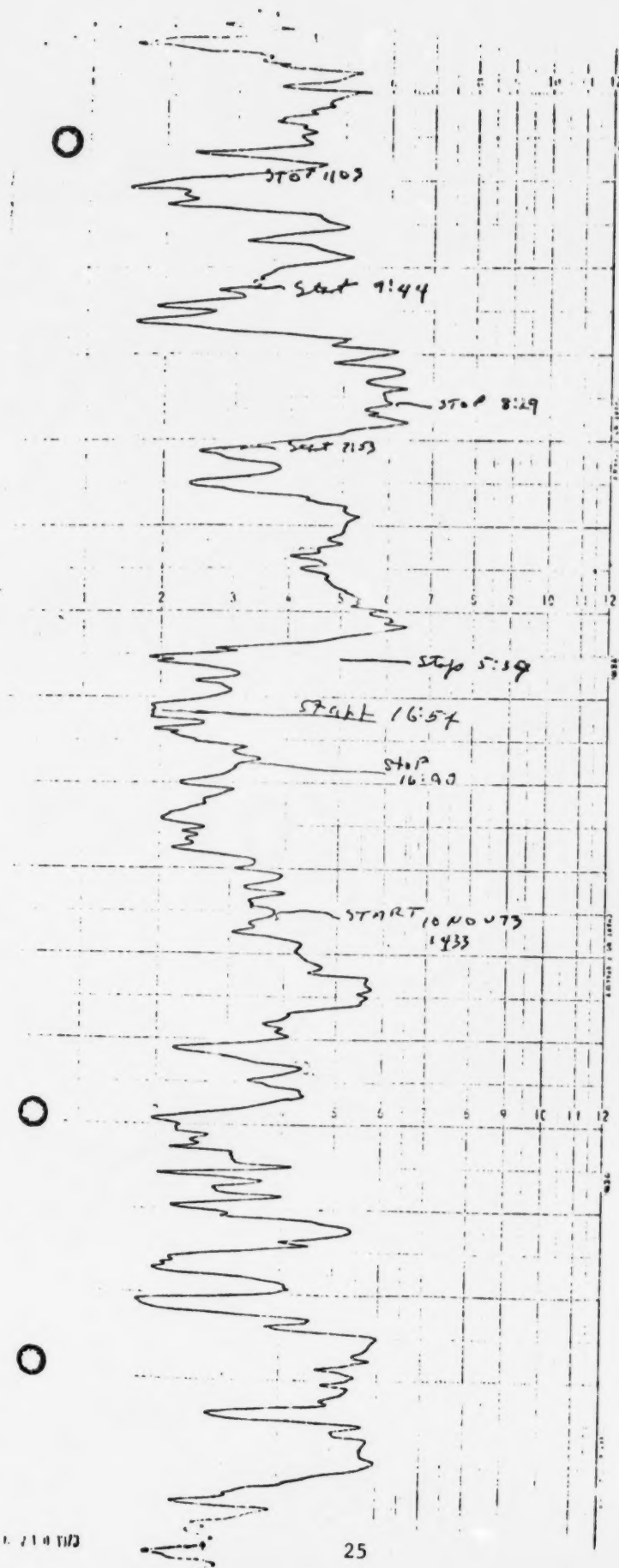


11-9-73

SO₂ %

CONVERTER OFFGAS
SO₂ CONCENTRATION
vs. TIME

Figure 8
(continued)

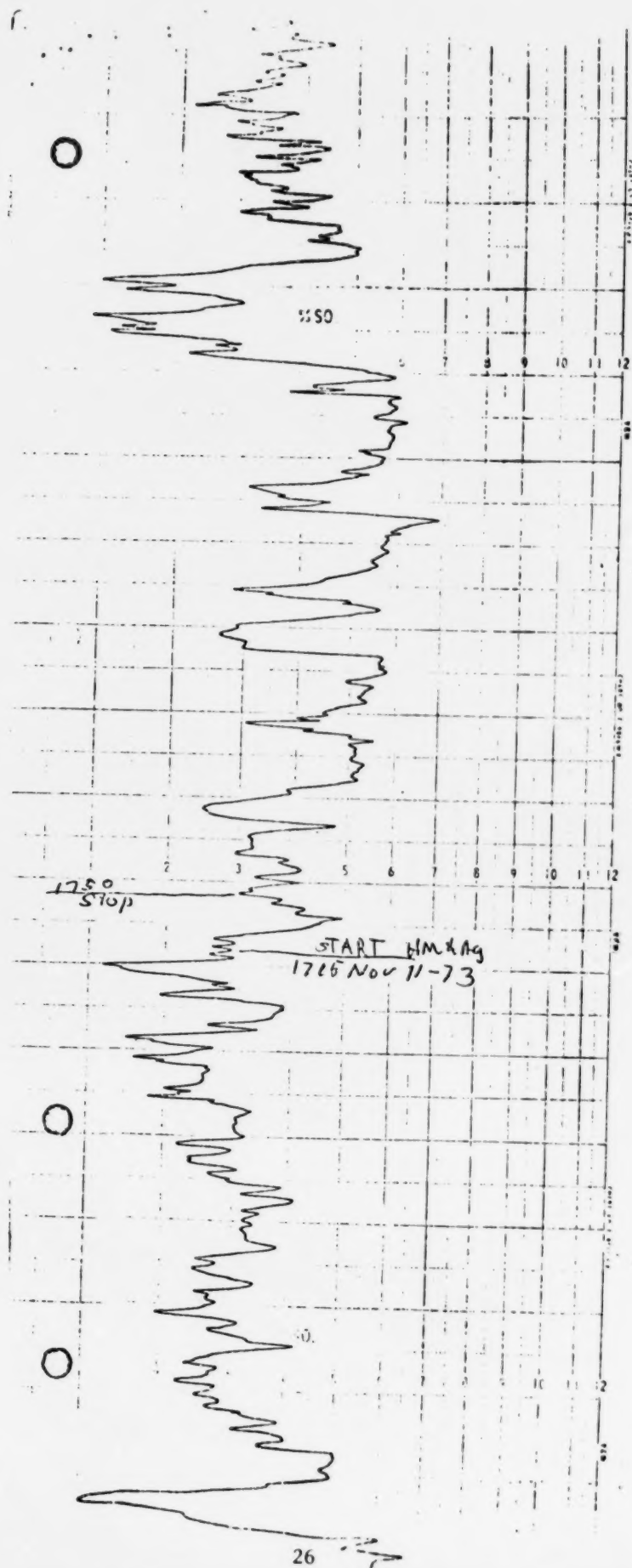


11-10-73

SO₂ %

CONVERTER OFFGAS
SO₂ CONCENTRATION
vs. TIME

Figure 8
(continued)



11-11-73

SO₂ %

CONVERTER OFFGAS
SO₂ CONCENTRATION
vs. TIME

Figure 8
(continued)

I. STACK DESCRIPTION

Main Stack

Height	828 feet
Diameter at exit	16 feet ID

As seen in Figure 9, the main stack, designed by MW Kellogg, consists of a column and liner. Column and liner dimensions at the base and at the top are indicated in the drawing. Roaster and reverberatory furnace gases are discharged through this stack as well as converter gases bypassing the acid plant during acid plant upsets.

Acid Plant Stack*

Height	100 feet
Diameter at exit	5.5 feet
Average gas temperature	146°F
Average gas velocity	58 ft/sec.

* Data and averages from Reference 7.

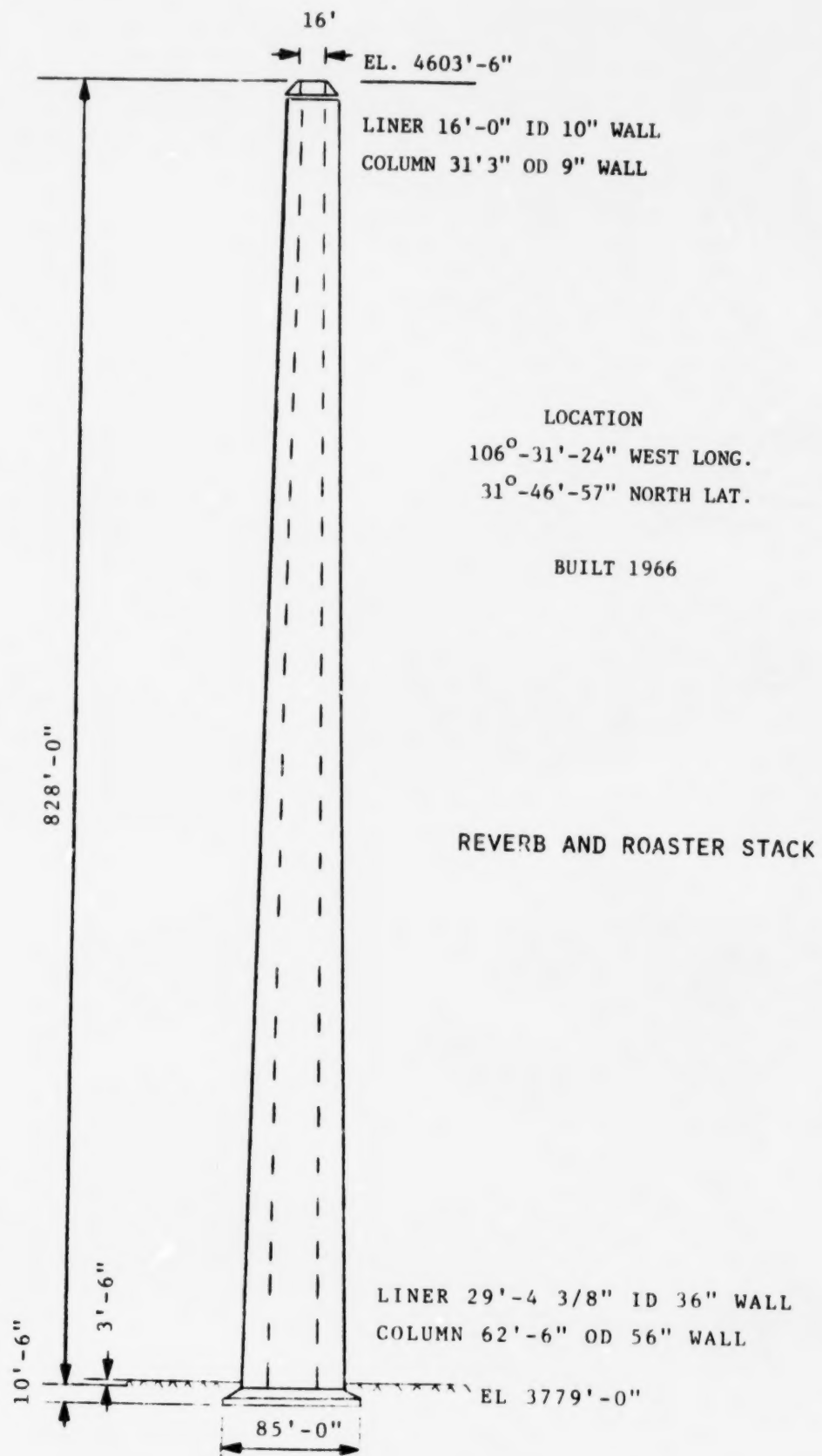
J. PRESENT TECHNIQUE FOR SOLID WASTE HANDLING

Slag from the reverberatory furnace is taken to the slag dump in a ladle transported by a rubber tired vehicle. Dust from the precipitators is taken by conveyor to a pug mill and then transported by rail car to the bedding bins.

K. FOOTING AND STRUCTURAL REQUIREMENTS

Wind Load	30 PSF
Snow Load	20 PSF
Seismic Zone	2
No local code requirements	

Preparation of the acid plant site uncovered boulder slag to a depth of 30 feet. Column supports should be considered required to this depth.



L. EXISTING AND POTENTIALLY AVAILABLE UTILITIES

Electric supply, particularly transformers, is operating at near capacity. Any large additional needs will require a second substation.

City water is used with some river water. A 6" meter has been used and an additional 8" meter installed for the acid plant. Water supply appears adequate for some additional requirements.

Gas is available but could be limited within the next few years.

M. POTENTIAL NEW CONTROL EQUIPMENT INSTALLATION PROBLEMS

Space between the reverberatory roaster Cottrell and the Wedge Roaster Building No. 2 appears available for installation of new control equipment. Space in other areas is limited.

Large electrical requirements will necessitate addition of a new substation.

REFERENCES

1. Replies for SO₂ Control Strategy for the El Paso Plant transmitted in a letter dated August 12, 1974 from R.K. Goleman to M. Peters, Texas Air Control Board.
2. Pollution Abatement Projects, American Smelting and Refining Company, El Paso Copper Department.
3. Outline of Metallurgical Practice, Third Edition, Howard, C.R. D. Von Nostrand & Company, 1952.
4. Texas Air Control Board
1973 Emissions Inventory Questionnaire
American Smelting and Refining Company, El Paso, Texas
dated May 7, 1974.
5. Source Surveillance Investigator's Report Form
Texas State Department of Health, Air Pollution Control Services
dated February 4, 1974.
6. Personal Communication Mr. E. Godsey ASARCO Central Engineering
June 27, 1975.
7. Report on Stack Sampling of American Smelting and Refining Company, El Paso, Texas, Texas Air Control Board January 7, 1974.
8. ASARCO comments on draft report transmitted by letter dated October 15, 1975 from E.S. Godsey.